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THE EFFECT OF NITROGEN AND PHOSPHORUS APPLICATION ON FLOWERING AND YIELD OF AFRICAN MARIGOLD (*TAGETES ERECTA* L.) CV. LOCAL SELECTION

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ABSTRACT

A nutritional trial was conducted on African marigold during 2004-05 and 2005-06 at CCS Haryana Agricultural University, Hisar to study the optimum requirement of nitrogen and phosphorus for better flower production in African marigold cv. Local selection. Observations were recorded on various floral (days to bud initiation, number of buds per plant, number of flowers per plant, days to flowering, duration of flowering, flower diameter and stalk length) and yield parameters (fresh and dry weight of flower, flower yield per plant and flower yield per hectare). There were 15 treatments viz. five levels of nitrogen (0, 10, 20, 30 and 40 g/m^2) and three levels of phosphorus (0, 10, and 20 g/m^2). A uniform dose of potassium @ 10 g/m^2 and 10 kg FYM per plot (1.2 m x 1.2 m) was applied. For statistical analysis factorial randomized block design with three replications was used. Application of nitrogen @ 30 g/m^2 and phosphorus @ 20 g/m^2 significantly improved the floral and yield parameters.

KEYWORDS: African Marigold, Nitrogen, Phosphorus, Flowering & Yield

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INTRODUCTION

Among the many flowering plants in India, marigold is one of very important ones. Its cultivation has done very well on a commercial scale in the northern part of India. The loose flower marketing has been practiced for worship, garland making, general decoration. Due to more urbanization and increasing aesthetic value in modern society and civilization, the demand of the loose flowers is increasing tremendously. Therefore, the present study was planned to find nitrogen and phosphorus for better flower yield in marigold.

MATERIAL AND METHODS

The present investigation was carried out at the Department of Horticulture, CCS Haryana Agricultural University, Hisar, India for two years, during 2004 and 2005. The experiment was laid out in a factorial randomized block design with three replications. There were 15 treatment viz. five levels of nitrogen (0,10,20,30 and 40 g/m^2) and three levels of phosphorus (0,10, and 20 g/m^2) with a single constant level of potassium 10 g/m^2 along with 10 kg/plot (1.2 m x 1.2 m) of farm yard manure (FYM). The full dose of FYM, P2O5, K2O and half of N were applied as basal dressing and remaining half of nitrogen was applied 30 days after transplanting. One month old seedlings of almost equal size and vigour were transplanted in the plots of size having 1.20 m × 1.20 m at a spacing of 40 cm × 40 cm. The pinching was done four weeks after transplanting.

RESULTS AND DISCUSSION

Floral Parameters

The results presented in Table 1 indicate that the different levels of nitrogen and phosphorus proved effective in influencing the floral development in terms of days to bud initiation, number of buds per plant, number of flowers per plant, days to flowering, duration of flowering, flower diameter and stalk length, which increased with the increasing levels of nitrogen up to 30 g/m^2 and phosphorus up to 20 g/m^2. The treatment combination of nitrogen 30 g/m^2 with phosphorus 20 g/m^2 gave better results in all floral parameters.

The decreased floral parameters at higher nitrogen levels (40 g/m^2) might be due to the imbalance in the availability of other nutrients or the requirement of the crop was fully met with the application of 30 g N/m^2. It was also observed that the buds significantly took more days for initiation with the increase in nitrogen and phosphorus levels (Tables 1). The possible reason for such delayed bud initiation might be due to the fact that plant receiving higher doses of nitrogen and phosphorus produced luxuriant vegetative growth due to the abundant supply of nutrients, thus leading to delayed bud initiation. Similar results were obtained by Vijayeshwari (1987); De and Dhiman (1998); Chadha *et al.* (1999); Sehrawat *et al.* (2003) in chrysanthemum. Hosoya *et al.* (1978) also reported that more protein and protoplasm will form from the carbohydrates and the amount of carbohydrates stored will be very less in vegetative parts. Since the nature of protoplasm is hydrated which results in the succulence of plants and delayed bud formation.

The number of buds per plant increased significantly with the increase in nitrogen levels from 0 to 30 g/m2 beyond which it decreased significantly. With the increase in phosphorus levels from 0 to 20 g/m2 enhanced number of buds per plant. The treatment combination of N 30 g/m2 with P 20 g/m2 resulted in maximum number of buds (Table 1). This increase in number of buds per plant could be explained on the basis that at the onset of the reproductive phase, the vegetative growth seized and thereafter the manufactured food material was utilized exclusively by the sink resulting in increased number of buds per plant. The significant decrease in number of buds per plant with higher dose of N 40 g/m2 might have been resulted because of the imbalance in the availability of other essential nutrients from the soil, which ultimately reflected in reduced number of buds per plant. At higher level of nutrient the plant growth decreased due to toxicity of the particular plant nutrient which directly or indirectly supress the uptake of other essential nutrient which ultimately decreased the growth.

Table 1: The Effect of Nitrogen and Phosphorus on Floral Parameters in African Marigold

Treatment	Days to bud Initiation		Number of Buds per Plant		Number of Flowers per Plant		Days to Flowering		Duration of Flowering		Flower Diameter (cm)		Stalk Length (cm)		Flower Yield per Hectare (t)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Nitrogen Levels (g/m^2)																
0	33.8	36.7	51.3	55.8	46.2	50.1	47.3	51.4	52.6	57.5	5.26	5.22	4.85	5.27	19.1	22.0
10	37.3	40.1	63.7	68.3	52.4	56.2	54.1	58.0	58.8	63.1	6.14	6.05	5.68	6.09	23.6	26.7
20	38.9	41.1	71.5	75.5	57.9	61.1	58.2	61.4	61.6	65.0	6.68	6.52	6.33	6.68	27.1	29.8
30	41.6	43.2	77.1	80.4	64.3	66.9	61.3	63.7	64.3	66.9	7.06	6.84	6.67	6.94	32.3	34.7
40	41.4	42.5	71.5	73.0	61.8	63.4	60.3	61.9	63.5	65.2	6.60	6.33	6.55	6.72	29.1	31.1
Phosphorus Levels (g/m^2)																
0	36.1	38.3	62.4	66.3	52.9	56.1	54.6	57.8	58.9	62.4	5.76	5.63	5.59	5.92	22.8	25.8
10	39.4	41.6	67.7	71.5	57.3	60.2	56.2	59.3	59.9	63.5	6.22	6.08	6.11	6.44	26.8	29.4
20	40.3	42.3	70.9	74.1	59.3	62.3	57.9	60.8	61.7	64.8	7.06	6.88	6.35	6.66	29.0	31.4
C.D. (P=0.05)																
Nitrogen	1.9	2.0	2.3	2.4	1.5	1.6	2.6	2.7	1.7	1.8	0.31	0.30	0.22	0.23	1.3	1.5
Phosphorus	1.5	1.6	1.8	1.9	1.2	1.3	N.S.	N.S.	N.S.	N.S.	0.24	0.23	0.17	0.18	1.0	1.1
Nitrogen X Phosphorus	N.S.	N.S.	4.0	4.2	2.7	2.8	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	2.3	2.5

Duration of flowering increased significantly with the increase in nitrogen levels up to 30 g/m^2 beyond which it decreased at 40 g/m^2. Phosphorus and its combinations with nitrogen did not affect the duration of flowering (Table 1). The increased duration of flowering due to the application of nitrogen could have resulted because of the increased availability of nitrogen in the root zone, which led to the optimum uptake of water and nutrients from the soil. Further, the increase in duration of flowering was probably due to the development of side branches and flowering continued for a longer period resulting in the extended duration of flowering.

The increase in nitrogen and phosphorus levels significantly increased the number of flowers per plant, flower diameter and stalk length up to 30 g/m^2, beyond which it declined and 20 g/m^2, respectively (Table 1). The possible reason for this is that if once the optimum requirement of the plant is met the further increase will not benefit the plant. The treatment combination of N 30 g/m^2 and P 20 g/m^2 resulted in maximum number of flowers per plant, flower diameter and stalk length. The increase in the number of flowers per plant due to the nitrogen and phosphorus application may be attributed to the fact that application of nitrogen and phosphorus increased the number of branches per plant and plant spread which ultimately increased the number of flowers per plant. The increase in stalk length due to nitrogen and phosphorus application might be due to the fact that nitrogen being the most important constituent of proteins, amino acids, enzymes and co-enzymes responsible for cell division and elongation. Similarly, phosphorus is associated with phosphorylation and the production of ATP, a compound required to maintain equilibrium between biochemical and enzymatic reaction in the plant, which might have resulted in increased flower diameter and stalk length. The increased flower size with nitrogen application could be explained in the light of the fact that balanced application of nitrogen resulted in increased carbohydrate assimilation leading to increased vegetative growth. These carbohydrates once translocated to productive organs undergo hydrolysis and get converted into the reducing sugars which ultimately helped in increasing flower size (diameter and stalk length). Phosphorus application also increased the flower size and stalk length due to stimulation in root growth which helped in better root development resulting in more absorption of water and mineral nutrients from soil and ultimately the flower size and stalk length improved. Similar observations have also been reported by Yadav *et al.* (2000).

Yield Parametrs

The fresh and dry weight of flower, flower yield per plant and flower yield per hectare increased with the increase in nitrogen levels from 0 to 30 g/m2, beyond which it decreased and phosphorus levels from 0 to 20 g/m2, respectively (Table 2). The increased yield as a result of nitrogen application could be explained on the basis that with the onset of flowering phase there is subsistence anabolic activities and redistribution of organic and organic nutrient components. As the plant enters into the reproductive phase the vegetative growth ceases to develop anymore, thus, the nitrogen, which was earlier been utilized by vegetative part, was translocated towards reproductive organs where it combined with the oxygen being evolved during photosynthesis and formed amino acids. On condensation, these amino acids formed proteins which ultimately increased the number of flowers per plant and fresh weight and dry weight of the flower.

Table 2: The Effect of Nitrogen and Phosphorus on Yield Parameters in African Marigold

Treatment	Average Fresh Weight of Flower (g)		Average Dry Weight of Flower (g)		Flower Yield per Plant (g)		Flower Yield Per Hectare (t)	
	2004	2005	2004	2005	2004	2005	2004	2005
Nitrogen Levels (g/m^2)								
0	8.04	8.02	0.75	0.74	341.1	392.7	19.1	22.0
10	8.74	8.64	0.83	0.82	421.9	475.7	23.6	26.7
20	9.07	8.88	0.88	0.85	532.9	582.1	27.1	29.8
30	9.71	9.43	0.96	0.93	575.5	619.3	32.3	34.7
40	9.18	8.77	0.92	0.88	518.5	549.0	29.1	31.1
Phosphorus Levels (g/m^2)								
0	8.52	8.32	0.81	0.79	427.4	472.8	22.8	25.8
10	9.02	8.80	0.88	0.86	491.1	536.7	26.8	29.4
20	9.31	9.12	0.91	0.89	515.5	561.8	29.0	31.4
C.D. (P=0.05)								
Nitrogen	0.35	0.34	0.03	0.03	23.9	25.9	1.3	1.5
Phosphorus	0.27	0.26	0.02	0.02	18.5	20.1	1.0	1.1
Nitrogen X Phosphorus	0.60	0.58	0.06	0.06	41.3	44.9	2.3	2.5

The increased flower yield as a result of phosphorus application seems to be due to the improvement in yield parameters due to the stimulation in root growth, which helped in better absorption of water and mineral nutrients from the soil. The combined influences of increased number of flowers per plant and average weight of flower resulted in increased flower yield. Phosphorus is associated with phosphorylation and is a constituent of energy rich compounds like ATP, ADP, NADH and NADPH. These energy rich metabolites ultimately increased the number of flowers per plant and weight of flowers. Improvement in yield parameters as a result of phosphorus application might have been due to the combined influence of number of flowers per plant and average weight of the flower. Also flower yield seems to be positively correlated with all the growth parameters, flower diameter, stalk length and these characters are the deciding characters which had a final control on the yield. Supply of nitrogen and phosphorus to the plant resulted in the proper development of the required photosynthetic system. Anuradha *et al*. (1988b) made correlation studies between the flower yield and yield attributing characters. The flower yield was significantly and positively correlated with plant height, number of branches at maturity, number of flowers per plant, flower diameter, stalk length and N, P and K content at flowering. Ravindran *et al*. (1986) also revealed that the correlation of yield with attributes plant height, number of primary branches per plant, flower size and number of flowers per plant were positive and significant, indicating that the increases in the above yield attributes resulted in increased yield of African marigold. They further reported that positive and significant correlation also existed between flower yield and N content of plant at different stages of crop growth indicating that the increased flower yield was due to the increased N content of the plant.

Decreased yield parameters at higher nitrogen levels (40 g/m^2) might be due to the imbalance in the availability of other nutrients or the requirement of the crop was fully met with the application of 30 g N/m^2. At higher level of nutrient the plant growth decreased due to toxicity of the particular plant nutrient which directly or indirectly suppress the uptake of other essential nutrient, which ultimately decreased the yield of the plant. Arora and Khanna (1986) reported similar findings in marigold and Singh and Tiwari (1993) in chrysanthemum. The excessive use of N beyond a certain limit was wasteful besides resulting in deleterious effects on soil structure (Nijjar, 1985).

CONCLUSIONS

Among 15 treatments viz. five levels of nitrogen (0, 10, 20, 30 and 40 g/m^2) and three levels of phosphorus (0, 10, and 20 g/m^2). Application of nitrogen @ 30 g/m^2 and phosphorus @ 20 g/m^2 significantly improved the floral and yield parameters.

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